Complete Summary

GUIDELINE TITLE

Imaging of blunt abdominal trauma.

BIBLIOGRAPHIC SOURCE(S)

Shuman WP, Holtzman SR, Bree RL, Bettmann MA, Casciani T, Foley WD, Gay SB, Gomes AS, Rosen MP, Sacks D, Greene FL, Expert Panel on Gastrointestinal Imaging. Imaging of blunt abdominal trauma. [online publication]. Reston (VA): American College of Radiology (ACR); 2005. 8 p. [98 references]

GUIDELINE STATUS

This is the current release of the guideline.

This guideline updates a previous version: Shuman WP, Ralls PW, Balfe DM, Bree RL, DiSantis DJ, Glick SN, Levine MS, Megibow AJ, Saini S, Greene FL, Laine LA, Lillemoe K, Berland L. Imaging of blunt abdominal trauma. American College of Radiology. ACR Appropriateness Criteria. Radiology 2000 Jun;215(Suppl):143-51.

The appropriateness criteria are reviewed annually and updated by the panels as needed, depending on introduction of new and highly significant scientific evidence.

COMPLETE SUMMARY CONTENT

SCOPE

DISEASE/CONDITION(S)

Blunt abdominal trauma

GUIDELINE CATEGORY

Diagnosis

CLINICAL SPECIALTY

Emergency Medicine
Radiology
Surgery

INTENDED USERS

Health Plans
Hospitals
Managed Care Organizations
Physicians
Utilization Management

GUIDELINE OBJECTIVE(S)

To evaluate the appropriateness of initial radiologic examinations for patients with blunt abdominal trauma

TARGET POPULATION

Adults with blunt abdominal trauma

Note: Penetrating trauma and pediatric cases are not considered.

INTERVENTIONS AND PRACTICES CONSIDERED

1. X-ray
    - Chest, upright
    - Abdomen, supine and upright
    - Cystogram
2. Computed tomography (CT)
    - Abdomen and pelvis
    - Cystogram, abdomen and pelvis
3. Invasive (INV)
    - Angiography embolization
    - Renal angiogram
4. Ultrasound (US)
    - Screen for hemoperitoneum
    - Organ sonogram
    - Bladder
5. Magnetic resonance imaging (MRI)
    - Organ evaluation
    - Diaphragm evaluation
    - Kidneys and bladder
6. Retrograde urethrogram
7. Intravenous urography (IVU)

MAJOR OUTCOMES CONSIDERED

Utility of radiologic examinations in differential diagnosis

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

The guideline developer performed literature searches of peer-reviewed medical journals, and the major applicable articles were identified and collected.

NUMBER OF SOURCE DOCUMENTS

The total number of source documents identified as the result of the literature search is not known.

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Weighting According to a Rating Scheme (Scheme Not Given)

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Not stated

METHODS USED TO ANALYZE THE EVIDENCE

Systematic Review with Evidence Tables

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

One or two topic leaders within a panel assume the responsibility of developing an evidence table for each clinical condition, based on analysis of the current literature. These tables serve as a basis for developing a narrative specific to each clinical condition.

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus (Delphi)

DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

Since data available from existing scientific studies are usually insufficient for meta-analysis, broad-based consensus techniques are needed for reaching agreement in the formulation of the appropriateness criteria. The American College of Radiology (ACR) Appropriateness Criteria panels use a modified Delphi

technique to arrive at consensus. Serial surveys are conducted by distributing questionnaires to consolidate expert opinions within each panel. These questionnaires are distributed to the participants along with the evidence table and narrative as developed by the topic leader(s). Questionnaires are completed by the participants in their own professional setting without influence of the other members. Voting is conducted using a scoring system from 1 to 9, indicating the least to the most appropriate imaging examination or therapeutic procedure. The survey results are collected, tabulated in anonymous fashion, and redistributed after each round. A maximum of three rounds is conducted and opinions are unified to the highest degree possible. Eighty percent agreement is considered a consensus. This modified Delphi technique enables individual, unbiased expression, is economical, easy to understand, and relatively simple to conduct.

If consensus cannot be reached by this Delphi technique, the panel is convened and group consensus techniques are utilized. The strengths and weaknesses of each test or procedure are discussed and consensus reached whenever possible. If "No consensus" appears in the rating column, reasons for this decision are added to the comment sections.

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

METHOD OF GUIDELINE VALIDATION

Internal Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

Criteria developed by the Expert Panels are reviewed by the American College of Radiology (ACR) Committee on Appropriateness Criteria.

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

ACR Appropriateness Criteria®

Clinical Condition: Blunt Abdominal Trauma, Adults

Variant 1: Stable patient.

Radiologic Exam Procedure	Appropriateness Rating	Comments

Radiologic Exam Procedure	Appropriateness Rating	Comments
X-ray, chest, upright	8	Computed tomography (CT) and x-rays may be appropriate. See original guideline document text for details.
X-ray, abdomen, supine and upright	8	CT and x-rays may be appropriate. See original guideline document text for details.
CT, abdomen & pelvis	8	Multidetector CT (MDCT) is preferable. CT and x-rays may be appropriate. See original guideline document text for details
INV, angiography embolization	8	Not a screening procedure. Angiography is indicated to delineate and treat active bleeding or other lesions amenable to angiographic therapy, but only when this type of lesion is first detected or suspected, either by CT or by some other means.
US, screen for hemoperitoneum	4	Low sensitivity of ultrasound to injuries that require surgery (active hemorrhage, viscus perforation) and its inability to exclude injuries that require in-hospital observation lessen its usefulness for key triage decisions.
US, organ sonogram	3	
MRI, organ evaluation	2	
MRI, diaphragm evaluation	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1 = Least appropriate 9 = Most appropriate		

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 2: Unstable patient.

Radiologic Exam Procedure	Appropriateness Rating	Comments
X-ray, chest, upright	7	
US, screen for	7	

Radiologic Exam Procedure	Appropriateness Rating	Comments
hemoperitoneum		
X-ray, abdomen, supine and upright	6	
US, organ	4	
INV, angiography embolization for bleeding	4	
CT, abdomen & pelvis	4	MDCT is preferable. Clinical judgment needed on stability of patient versus need for diagnostic information.
MRI, organ evaluation	2	
MRI, diaphragm evaluation	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1 = Least appropriate 9 = Most appropriate		

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 3: Hematuria > 35 Red Blood Cells (RBC) / High Power Field (HPF) (stable).

Radiologic Exam Procedure	Appropriateness Rating	Comments
X-ray, chest, upright	8	CT and x-rays may be appropriate. See original guideline document text for details.
X-ray, abdomen, supine & upright	8	CT and x-rays may be appropriate. See original guideline document text for details.
CT, abdomen & pelvis	8	MDCT is preferable. CT and x-rays may be appropriate. See original guideline document text for details.
CT cystogram, abdomen & pelvis	7	
Retrograde urethrogram	7	If urethral injury is suspected.

Radiologic Exam Procedure	Appropriateness Rating	Comments
IVU	4	
X-ray, cystogram	4	
INV, renal angiogram	4	
US, organ	3	
US, bladder	3	
MRI, kidneys and bladder	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1 = Least appropriate 9 = Most appropriate		

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

This review considers only the issue of blunt abdominal trauma in adults. Penetrating trauma and pediatric cases are not considered.

Category A

Hemodynamically unstable patients presenting to the emergency room with clinically obvious major abdominal trauma and with unresponsive profound hypotension need rapid clinical evaluation and immediate resuscitation with volume replacement. If such unstable patients do not respond to resuscitation (become hemodynamically stable), and if they have clear clinical evidence of abdominal injury, they should go immediately to the operating room without imaging. During resuscitative efforts if time and circumstances permit, conventional radiographs of the chest and abdomen are often obtained as part of trauma protocols. This may help identify a pneumothorax, pneumoperitoneum, or significant bone injury. Ultrasound performed by an experienced sonologist to check for intraperitoneal free fluid may quickly provide information that can support a decision to operate immediately, with the caveat that the false negative rate is at least 15%. More detailed ultrasound to check for organ injury takes too long in this setting and suffers from poor sensitivity. There is now general agreement that routine diagnostic peritoneal lavage (DPL) is obsolete because of its invasive nature, lack of specificity, and inability to predict the need for therapeutic surgery.

Category B

Hemodynamically stable patients, patients with mild to moderate responsive hypotension presenting to the emergency room after blunt abdominal trauma, and unstable patients who stabilize after initial resuscitation are in a separate category. These patients typically have a history of significant trauma and have at

least moderate suspicion of intra-abdominal injury based on clinical signs and symptoms. For these patients, two decisions need to be made: (1) Is urgent therapeutic surgery or angiography needed? (2) If surgery is not needed, is a period of close observation warranted? If computed tomography (CT) is to be performed, plain films will offer little if any incremental help with those questions. Rather, the decision to proceed with urgent surgery depends on the identification of specific CT criteria that predict that the surgery will be therapeutic: active hemorrhage, parenchymal "blush" or pseudoaneurysm in the spleen, or perforation of a hollow viscus (including the pancreatic duct). In patients with active hemorrhage or pseudoaneurysm of the spleen, angiographic embolization may also be therapeutic. The decision to operate urgently does not solely depend on the identification of hemoperitoneum or the identification of parenchymal injury to the liver or spleen, because most patients in this category ultimately do not need surgery. However, accurate identification of hemoperitoneum or organ injury is important because patients with these findings require at least a period of close observation. Patients with multiple organ injury or significant active bleeding may need surgery even if they are hemodynamically stable. Conversely, stable patients with isolated organ injury may not need surgery (or may need only angiography plus embolization) even with a large amount of hemoperitoneum.

Either way, time is available in such patients to obtain chest and abdominal radiographs, a hematocrit plus blood chemistries, and a urinalysis. If a reliable abdominal exam can be performed (the patient is conscious and does not need prolonged anesthesia for other procedures) and all the above preliminary tests are unremarkable, a period of close observation may be all that is needed. However, if a reliable abdominal exam cannot be performed (patient is unconscious or prolonged nonabdominal surgery is anticipated) or if a clinical evaluation suggests organ injury, hemoperitoneum, or peritonitis, further imaging is needed.

At this point, ultrasound is not a good modality for further imaging because it misses up to 25% of liver and spleen injuries, most renal injuries, and virtually all pancreatic, mesenteric, and gut injuries. It also misses a high proportion of retroperitoneal hemorrhage and of bladder rupture. Combining the results for ultrasound in 1535 abdominal trauma patients from eight published series yields an average sensitivity for hemoperitoneum of 88% and for organ injury of 74%. Unfortunately, a negative ultrasound (absence of hemoperitoneum) does not rule out significant organ or viscus injury that might require surgery or observation.

Although ultrasound is 63% sensitive to moderate amounts of free intraperitoneal fluid (compared with computed tomography), 400 to 600 cc's are needed for ultrasound detection of fluid in the trauma setting. Almost regardless of volume, an ultrasound diagnosis of free fluid alone does not predict that surgery is needed or that surgery will be therapeutic. In addition, in the best of hands, there is at least a 15% false negative rate for detecting hemoperitoneum with ultrasound. Further, ultrasound is quite insensitive in detecting organ injury: 62% of spleen and 14% of liver injuries are missed compared with computed tomography and operative findings. Ultrasound poorly identifies active hemorrhage and also does not accurately predict the need for surgery in splenic injuries.

Ultrasound is also insensitive to perforation of gut and to pancreatic injury. For these reasons, it is not very useful in deciding when a patient needs urgent therapeutic surgery or angiography. For the same reasons, ultrasound is not an

accurate modality to determine whether a patient needs a period of close observation; thus, if a negative ultrasound is the sole imaging modality used to triage a patient, for safety reasons it must be followed by a 12- to 24-hour period of in-hospital observation. It should be noted that 96% of trauma centers perform fewer than two trauma ultrasound exams per month, so there is currently little national experience with or teaching of trauma ultrasound.

In contrast, for category B trauma patients, computed tomography accurately predicts if therapeutic surgery is urgently needed by identifying active hemorrhage, splenic injury (either parenchymal contrast blush or pseudoaneurysm), gut perforation, and pancreatic injury. For these reasons, it is an excellent modality for deciding whether a patient needs urgent therapeutic surgery or is a candidate for therapeutic angiography. Because computed tomography is sensitive in detecting both hemoperitoneum and injury to the liver (sensitivity 93%) and spleen (sensitivity 95%), it is an accurate modality for deciding if a patient needs a period of close observation. The trend toward placing helical computed tomography scanners close to or in emergency departments has substantially diminished the delay in getting patients to the computed tomography scanner and has decreased actual scan time to less than 40 seconds. In most circumstances, results from a helical computed tomography of the abdomen and pelvis can be obtained faster than results from a detailed ultrasound that includes evaluation of abdominal organs and gut.

If multidetector computed tomography with rapid image display capability is available in or next to an emergency department, abdominal computed tomography can be performed in about 2 minutes - excluding time needed for patient transport, computed tomography scan setup, and archiving of images. Including all time requirements, patient turnaround with rapid-process multidetector computed tomography can be less 10 minutes for a trauma patient. For single-slice incremental computed tomography, turnaround time is somewhat longer, usually 20 minutes. Scanning multiple body regions increases these times variably.

An experienced radiologist should carefully examine images on film, picture archiving and communication system (PACS), or at the computed tomography console, where images can be altered to seek bone injury, pneumoperitoneum, or subtle organ injury. Particular care should be taken to find minimal injury of the spleen because these patients may need observation for potential delayed hemorrhage. In some instances, stable patients with more severe injuries of the liver or spleen plus hemoperitoneum may be managed conservatively with only close observation. It should be noted, however, that various schemes for using computed tomography to grade liver or spleen lacerations are not helpful in deciding whether a patient needs surgery. This decision must be based on the clinical status of the patient in combination with the image findings. If evidence of active hemorrhage is discovered on computed tomography exams, the patient may be taken to the operating room or undergo arteriography plus embolization to control the hemorrhage.

The computed tomography exam should be carefully examined for subtle signs of pancreatic injury because these patients may need immediate surgery or close observation for signs of complications. Duodenal perforation produces subtle but frequent findings on computed tomography, e.g., typically extraluminal air or

contrast in the retroperitoneum or elsewhere; these findings mandate surgical intervention. Duodenal hematoma may not require surgery but does need close observation. Other gut injury or perforation produces direct or indirect findings on computed tomography in 50% to 94% of cases. However, if the computed tomography is negative for gut injury in the face of a high clinical suspicion, diagnostic peritoneal lavage, laparoscopy, or a period of observation plus repeat computed tomography may be used to further evaluate the patient.

There may be a rationale for creating a subcategory of stable patients with trivial trauma, a low clinical index of suspicion, and no signs or symptoms of intraabdominal injury. In such patients, a negative ultrasound alone may be adequate to release the patient from observation at a lower cost than if computed tomography had been used. Computed tomography is necessary, however, if there are any positive findings on ultrasound.

It may also be reasonable to use computed tomography, in conjunction with the clinical information, to decide whether to observe patients in the hospital for a day or send them home promptly at the completion of their investigation in the emergency department. The high sensitivity of computed tomography in detecting injuries that require observation in the hospital means that a negative computed tomography may be adequate to release the patient to home in selected cases. Ultrasound has a substantially lower sensitivity to the kind of injuries that must be observed in the hospital. For this reason, a negative ultrasound is not adequate to safely release the patient to home. This weakness of ultrasound is reflected in the design of many outcomes-based investigations on the use of ultrasound in trauma: all keep patients with a negative ultrasound in the hospital for a period of observation of 12 to 48 hours before release.

Category C

Patients with hematuria require some modification to the imaging workup. Patients with microscopic hematuria (less than 35 red blood cells per high power field) do not need specific urinary tract imaging. All patients with microscopic hematuria greater than 35 red blood cells per high power field, with macroscopic hematuria, or with fracture/diastasis of the symphysis pubis and its rami plus any hematuria need imaging of the urinary tract. If the urethral meatus has gross blood, if there is a floating prostate, or if a Foley catheter cannot be passed, a retrograde urethrogram should first be performed to rule out urethral injury. However, if clinical evaluation or the urethrogram indicates no urethral injury, a computed tomography cystogram should be added to the abdominal computed tomography (see appendix to the original guideline document). Computed tomography images should be examined carefully for evidence of renal perfusion, hemorrhage, or extravasation of contrast or urine from the kidney or bladder. Two studies have documented the poor ability of ultrasound to detect injuries of the kidney. All but the worst renal injuries are treated with observation; intraperitoneal bladder rupture is usually treated with surgical repair.

Abbreviations

- CT, computed tomography
- INV, invasive
- IVU, intravenous urography

- MRI, magnetic resonance imaging
- US, ultrasound

CLINICAL ALGORITHM(S)

Algorithms were not developed from criteria guidelines.

EVIDENCE SUPPORTING THE RECOMMENDATIONS

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The recommendations are based on analysis of the current literature and expert panel consensus.

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

Selection of appropriate radiologic imaging procedures for evaluation of patients with blunt abdominal trauma

POTENTIAL HARMS

Not stated

QUALIFYING STATEMENTS

QUALIFYING STATEMENTS

An American College of Radiology (ACR) Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologist, radiation oncologist, and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those exams generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the U.S. Food and Drug Administration (FDA) have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

IMPLEMENTATION TOOLS

Personal Digital Assistant (PDA) Downloads

For information about availability, see the "Availability of Companion Documents" and "Patient Resources" fields below.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Getting Better

IOM DOMAIN

Effectiveness

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

Shuman WP, Holtzman SR, Bree RL, Bettmann MA, Casciani T, Foley WD, Gay SB, Gomes AS, Rosen MP, Sacks D, Greene FL, Expert Panel on Gastrointestinal Imaging. Imaging of blunt abdominal trauma. [online publication]. Reston (VA): American College of Radiology (ACR); 2005. 8 p. [98 references]

ADAPTATION

Not applicable: The guideline was not adapted from another source.

DATE RELEASED

1996 (revised 2005)

GUIDELINE DEVELOPER(S)

American College of Radiology - Medical Specialty Society

SOURCE(S) OF FUNDING

American College of Radiology (ACR) provided the funding and the resources for these ACR Appropriateness Criteria®.

GUIDELINE COMMITTEE

Committee on Appropriateness Criteria, Expert Panel on Gastrointestinal Imaging

COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

Panel Members: William P. Shuman, MD (Co-Author); Stephen R. Holtzman, MD (Co-Author); Robert L. Bree, MD, MHSA; Michael A. Bettmann, MD; Thomas Casciani, MD; W. Dennis Foley, MD; Spencer B. Gay, MD; Antoinette S. Gomes, MD; Max Paul Rosen, MD, MPH; David Sacks, MD; Frederick L. Greene, MD

FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

Not stated

GUIDELINE STATUS

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The appropriateness criteria are reviewed annually and updated by the panels as needed, depending on introduction of new and highly significant scientific evidence.

GUIDELINE AVAILABILITY

Electronic copies: Available in Portable Document Format (PDF) from the American College of Radiology (ACR) Web site.

ACR Appropriateness Criteria® Anytime, Anywhere™ (PDA application). Available from the ACR Web site.

Print copies: Available from the American College of Radiology, 1891 Preston White Drive, Reston, VA 20191. Telephone: (703) 648-8900.

AVAILABILITY OF COMPANION DOCUMENTS

The following is available:

- ACR Appropriateness Criteria®. Background and development. Reston (VA): American College of Radiology; 2 p. Electronic copies: Available in Portable Document Format (PDF) from the American College of Radiology (ACR) Web site.

PATIENT RESOURCES

None available

NGC STATUS

This summary was completed by ECRI on March 19, 2001. The information was verified by the guideline developer on March 29, 2001. This NGC summary was updated by ECRI on January 4, 2006. The updated information was verified by the guideline developer on January 19, 2006.

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